Claims

I claim:

1. A thin film composite solid suitable for use as an electrolyte comprising a first layer of a dense, non-porous ionically conductive material; a second layer of a porous material; and a third layer of a dense non-porous ionically conductive material, wherein said second layer has a CTE within 5% of the CTE of said first and third layers, said layers arranged in ascending order in said composite.

2. A thin film composite solid suitable for use as an electrolyte comprising a first layer of a porous material; a second layer of a dense non-porous ionically conductive material; and a third layer of a porous material; wherein said second layer has a CTE within 5% of the CTE of said first and third layers, said layers arranged in ascending order in said composite.

3. The thin film composite solid suitable for use as an electrolyte of claim 1 wherein said first, second and third layers comprises β-Al_2O_3.

4. The thin film composite solid suitable for use as an electrolyte of claim 1 wherein said first, second and third layer comprises β''-Al_2O_3.

5. The thin film composite solid suitable for use as an electrolyte of claim 1 wherein said first, second and third layer substantially consists of NASICON.

6. The thin film composite solid suitable for use as an electrolyte of claim 1 wherein said first and third layer has a thickness less than or equal to 50 microns.

7. The thin film solid composite suitable for use as an electrolyte according to claim 2 wherein said second layer was constructed from Nanoparticulate β''-Al_2O_3.

8. The thin film solid composite suitable for use as an electrolyte according to claim 1 wherein said first and third layers were constructed from Nanoparticulate β''-Al_2O_3.

9. The thin film solid composite suitable for use as an electrolyte according to claim 1 wherein said electrolyte is substantially planar.

10. A process of forming a three layered thin film composite solid suitable for use as an electrolyte comprising the steps of:

a. tape casting a series of sheets or films, each said sheet formed from at least two slip composites, wherein one of said slip composites is formed with a combustible pore former added (a "Porous Material"), and another of said slip composites is formed without said pore former material (a "Non Porous Material");

b. laminating said series of sheets to create a layered structure having at least three layers, where said three layers alternate between layers constructed from said Non-Porous Materials and layers constructed from said Porous Materials; and

c. sintering said three layered structure to a suitable temperature to densify said layer formed from said Non Porous Material to create an ionically conductive layer.

11. The process of claim 10 wherein said sintering step is performed at temperatures aqt or below about 1500 °C .

12. The process of claim 10 wherein said sintering step is performed at temperatures at or below about 1600 °C .

13. The process of claim 10 wherein said sintering step is performed without encapsulation of said three layered structure.

14. The process of claim 10 wherein said sintering step includes the sub step of raising the temperature to a first temperature, wherein said first temperature is sufficient to combust said pore former material, and then raising said temperature to a final temperature,

wherein said final temperature is sufficient to densify said layers constructed from said Non-Porous Materials.

15. The process of claim 14 wherein said substep of raising the temperature to a first temperature is undertaken at a rate to allow gases generated from combustion of said pore former to escape said three layer structure without delaminating said three layered structure in whole or in part.

16. The process of claim 12 wherein said step of sintering includes the step of raising the temperature to a first temperature suitable to allow combustion of said pore former; then raising said temperature to a second take off temperature, then raising the temperature to a final sintering temperature, wherein the rate of temperature rise from said second temperature to said final sintering temperature is at least about 10 °C /minute.

17. The process of claim 10 wherein said slips are further composed of β''-Al_2O_3 or β-Al_2O_3.

18. The process of claim 10 wherein said slips are further composed of NASICON.

19. The process of claim 10 wherein the thickness of said layers formed from Non-Porous Materials, after sintering, are less than 100 microns.

20. The process of claim 10 wherein the thickness of said layers formed from Porous Materials is greater than about 100 microns.

21. The process of claim 20 wherein said thickness of said layers formed from Porous Materials is sufficient to provide structural support to said thin film composite solid.

22. The thin film composite solid suitable for use as an electrolyte of claim 2 wherein said first layer, second and third layers comprises β-Al_2O_3.

23. The thin film composite solid suitable for use as an electrolyte of claim 2 wherein said first, second and third layer comprises β''-Al_2O_3.

24. The thin film composite solid suitable for use as an electrolyte of claim 2 wherein said first, second and third layer substantially consists of NASICON.

25. The thin film solid composite suitable for use as an electrolyte according to claim 2 wherein said electrolyte is substantially planar.